

The following is provided for informational purposes to prospective respondents to this Sources Sought Notice.

1. The Project Introduction first paragraph defines the TDM CPST as including, “all of the CPST technical project work, which includes a spaceflight demonstration, ground tests and model correlation.” In the third paragraph of Section 2, page 4, the SSN says, “Estimated award amount for the TDM CPST Project is \$150M over 5.5 years.” Please clarify whether the \$150M estimate encompasses the entire Project (Payload, spacecraft bus, integration and test, LV integration, ground processing, and mission operations) or just the Prime Contractor effort as defined in the first paragraph under Contractor Performance Statements found on page 9.

Response: The \$150 over 5.5 years is intended to cover only the Contractor Performance Statements starting on page 9.

2. There is an apparent inconsistency in the CPST SSN document regarding cryogenic propellant transfer. Draft Program Level requirement CPST-Prog-2 Demonstration of Propellant Transfer says, “Delivery of bubble-free cryogenic propellants in a manner extensible to full-scale space systems via transfer in microgravity without prior settling shall be demonstrated.” There is also a reference to unsettled transfer in the last sentence of the first paragraph on page 8, “NASA will most likely require a minimum of two transfers in an unsettled condition at two different fill levels in the storage tank.” However, two other locations refer to settled and unsettled transfer. In the next to last sentence of the second paragraph following the Program level requirements it says, “The mission duration is envisioned to be three to six months, which is based upon the time needed to complete Spacecraft checkout, demonstrate active and passive storage, and conduct transfer cycles under both unsettled and settled cryogenic liquid conditions.” In the second sentence of the third paragraph on page 8 it says, “This will include requirements for active and passive LH2 storage, settled and unsettled LH2 transfers, data collection, thermal and pressure control, etc.” Please clarify whether settled propellant transfer will be required during the demonstration mission, either as a demonstration of capability requirement or during transfer from the receiving tank back into the primary tank, if that is part of the concept and test definition.

Response: At this point the TDM Project has not determined whether settled transfer operations will be a firm requirement for the demonstration mission, that decision will be based on the final mission timeline. Settled transfer is considered a lower priority to demonstrate in the mission when compared to unsettled transfer. The capability to settle the propellant for a transfer may also be maintained as a fall-back option if the unsettled transfer does not function as planned.

3. The second paragraph following defined mission requirements CPST-PROG-1 through 5 says specific capabilities for “TDM CPST would include, but are not limited to, systems to provide zero boil-off storage of liquid oxygen...” The following paragraph says, “the cryogenic liquid to be used in the CPST Spacecraft is liquid hydrogen (LH2).” These two paragraphs seem to be at odds with each other. Please clarify the cryogenic fluid or fluids to be used in the CPST CFS Payload to demonstrate long duration storage.

Response: The current plan is for the flight system to only demonstrate cryogenic storage of liquid hydrogen (LH2). It is understood that the more difficult demonstration would be long-term storage of LH2. The project also plans ground testing different hardware to demonstrate capabilities for oxygen storage.

4. Section 2, fourth paragraph, lists information requested by the Sources Sought. Section 2, first paragraph, says NASA will use this data to determine the appropriate level of competition and/or small business subcontracting goals. Section 3, paragraph 1 lists only Section 1, Business Information, for the response content. Although not included in the list of data requested and the Volume I outline, one can infer that any response should include a discussion of company capabilities. Is this a correct inference?

Response: Yes, please provide a discussion of the company's capabilities.

5. What approach will NASA take to anchor performance models for the oxygen tank and thermal control system of the operational on-orbit cryogenic storage system to flight data if the demonstration system is hydrogen only?

Response: The project will collect flight data with liquid hydrogen to characterize the effect of gravity on the behavior of cryogenic fluids in a highly efficient storage and transfer system. These data will be used to anchor models for cryogenic fluid behavior and for interaction of the cryogen with CFM technologies in microgravity. Liquid hydrogen is the more challenging fluid for storage, microgravity liquid acquisition, and transfer principally due to its lower temperature, lower density, lower viscosity and lower surface tension. NASA believes it is reasonable to interpolate to oxygen behavior as oxygen properties tend to reside between hydrogen and non-cryogenic fluids with flight heritage and characterization. With respect to storage specifically, the intent for hydrogen storage in flight is to demonstrate a very small but non-zero loss; liquid oxygen testing will be conducted in a ground thermal vacuum chamber to demonstrate the ability to control tank pressure and prevent loss in a representative thermal and pressure environment (Zero Boil-Off or ZBO). These ground tests will both demonstrate the capability for ZBO and provide a separate data set with which the performance models can be anchored.

6. ALTHOUGH THERE IS NO SPECIFIC FORMAT REQUIREMENT OR PAGE COUNT LIMITATION FOR RESPONSES SUBMITTED IN RESPONSE TO THIS SOURCES SOUGHT NOTICE, RESPONDENTS SHOULD SUBMIT A CONCISE YET THOROUGH RESPONSE WITH ADEQUATE INFORMATION TO CONVEY THEIR CAPABILITIES AS WELL AS THE OTHER INFORMATION REQUESTED.